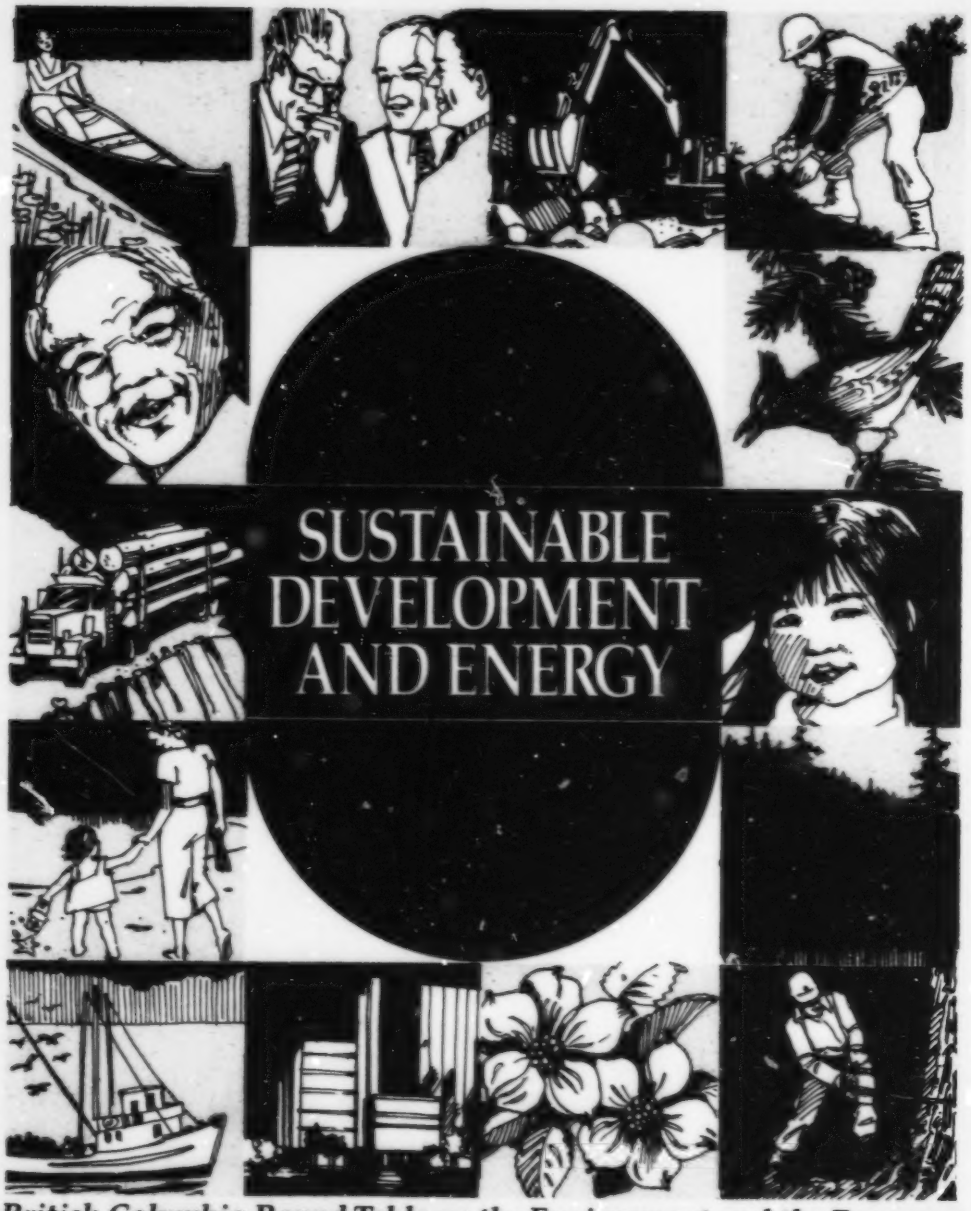

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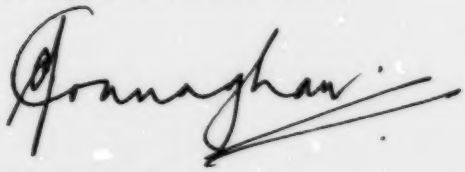
Preface

Sustainable Development and Energy is a theme paper developed by the British Columbia Round Table on the Environment and the Economy. Its content reflects a consensus by the Round Table members on a number of major issues and options related to energy.

This paper is intended to stimulate public discussion on the elements of a Sustainable Development Strategy for British Columbia. It is hoped that **Sustainable Development and Energy** will provide a starting point for dialogue and will assist in determining the goals and values held by the public. The ensuing dialogue may reveal other appropriate issues to be addressed by the Round Table. **Sustainable Development and Energy** is a companion to the Round Table's document **A Better Way**.

The Round Table welcomes your views and advice on this and other subjects related to a sustainable development strategy for British Columbia.



C.J. Connaghan
Chairman

Executive Summary

Energy is one of the foundations of British Columbia's economy and its development and use have significant impacts on our environment. This contrast of economic and environmental values is the challenge of sustainable development. The British Columbia Round Table on the Environment and the Economy has concluded that public discussion of our energy future is vitally important in the creation of a provincial sustainable development strategy, and is fostering that discussion through this theme paper.

The paper identifies four major issues: energy demand, energy supply, energy pricing, and global warming. It provides a brief discussion of each of these issues and identifies potential options for dealing with them.

Energy Demand

Energy use in British Columbia is amongst the highest in the world. The province's legacy of low energy prices has resulted in an energy - intensive industrial base, and exports such as pulp, paper, and metals have a major energy component.

The industrial sector is responsible for about half of the province's energy consumption, and the transportation sector for about one-quarter. Over the next 20 years, demand for energy services is expected to grow significantly as our population increases by nearly 50 per cent. We will continue to experience the trend toward more motor vehicles and intensified industrial energy requirements.

Options that would reduce our energy services include improving transportation efficiencies by making public transit and car pooling more appealing, modifying urban design, and encouraging industrial growth in secondary processing of our raw materials.

The most attractive option may be to maintain our current level of energy services while improving our technologies so that overall energy efficiency is optimized. Stronger conservation measures and alternative fuels with less damaging environmental impacts also must be seriously considered.

Energy Supply

Although much of British Columbia's energy needs are satisfied by domestic supplies of natural gas, hydroelectricity, woodwaste and other sources, the largest single component is imported oil. Given our demands for energy, the question is not whether we need new energy supplies, but rather when should they be developed and how can their environmental impacts be minimized.

Several key issues have been identified. These are that energy conservation and efficiency should be highly valued because of environmental benefits; that dependence on oil cannot be sustained in the long term; and that reliance on thermal generation projects to produce electricity may have more significant environmental impacts than hydroelectricity.

One of the options to consider is a comprehensive biennial energy plan that covers all fuel types and energy supplies. Other options include improved conservation measures integrated with least-cost planning (recognizing that energy should be saved first if it costs less than buying new supplies), and using oil substitutes such as natural gas and hydroelectric resources. Still another option to consider is the increased use of alternative fuels for transportation such as natural gas, electricity and, in due course hydrogen.

Pricing

Energy prices play a major role in determining the quantities and types of energy that are produced and consumed. In most cases our current electricity rates do not

reflect the full economic and environmental costs. Continuing to charge rates that do not reflect the full costs encourages excessive energy use and acts to accelerate early development of new resources.

One option that could be considered is full cost accounting — pricing energy to reflect all costs. A related option is to vary industrial electricity prices by region to reflect transmission costs.

Global Warming

As a result of increases in carbon dioxide and other greenhouse gases, atmospheric scientists predict a significant increase in Earth's temperature by the middle of the next century. Energy consumption is responsible for the addition of most of these gases to the atmosphere. Although on balance British Columbia's environment may absorb more carbon dioxide than is emitted, this world-wide warming and its related effects would have major environmental and economic implications for the Province.

Our options appear to be maintaining the status quo or implementing a "no-regrets" policy of actions that are economically and environmentally beneficial in their own right and also reduce emissions of greenhouse gases. A further option would be to develop a specific emissions reduction target based on all greenhouse gases that could go beyond a no-regrets policy.

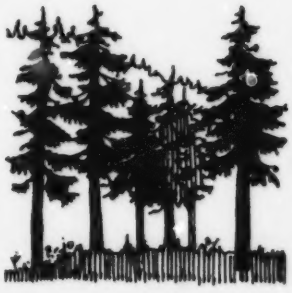
Introduction

Concerns related to the quality of our environment are increasingly dominating political and economic decision-making in Canada and throughout the world. Global warming, ozone depletion, air quality, acid rain, and industrial pollution are issues receiving almost daily attention by the media. The difference between the concern for the environment in the 1990's and that which occurred in the 1970's is the recognition of interdependencies between the economy and the environment, and that continued environmental deterioration will inevitably present barriers to future economic development activities.

This issue was brought to world attention in 1987 with the publication of the United Nations report that popularized the term sustainable development.[1] Although there are many interpretations of this term, it was originally expressed as, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Following this, a report by the British Columbia Task Force on Environment and Economy, **Sustaining the Living Land**, was released in 1989 that made a number of recommendations including development of a sustainable development strategy by the British Columbia Round Table on the Environment and the Economy.

The Provincial Government has charged the Round Table on the Environment and the Economy with fostering the development strategy for British Columbia. Such a strategy must embody a vision of the future that is shared by the people of British Columbia, and provide a "road map" to show us how we can ensure sustainability. The Round Table must engage in a public dialogue to understand and help develop this vision, and to discuss the major issues we face and the options that we have in developing our strategy for the future.

The purpose of this discussion paper is to examine the key sustainable development issues with respect to the energy sector and to identify options for public consideration. The issues identified are: energy demand, energy supply, energy pricing, and global warming. The paper provides a brief discussion of each issue and suggests options for the purpose of stimulating written and verbal public discussion.



[1] *The World Commission on Environment and Development, (1987)* ***Our Common Future.***

The Challenge

British Columbia has a small, resource based export economy that is closely linked to the global economy. Changes that occur in international and domestic markets affect the Provincial economy, which in turn has an impact upon our environment. British Columbia's economy tends to be volatile since economic growth closely follows international commodity prices. Business investment in the Province, a majority of which goes into the resource industries, tends to rise and fall with resource commodity markets. For example, one quarter of all business investment in 1990 occurred in the pulp and paper sector, which enjoyed several years of high prices that are now beginning to soften.

In British Columbia, our abundant energy resources of hydroelectricity, coal, and natural gas have helped our economy to be more internationally competitive by providing inexpensive alternatives to oil and by providing valuable energy exports to the United States. Exports of energy and energy intensive commodities such as aluminum, zinc, market pulp, and petrochemicals amounted to $6.6 billion in 1988. Nevertheless, continuation of high oil prices as a result of the Iraqi invasion of Kuwait will increase the cost of energy in British Columbia. There are also growing pressures to reduce the use of energy because of its environmental impacts. Although rising energy prices may reduce the world demand for some of our exports, the demand for energy intensive exports may be less affected.

British Columbia energy use measured by per capita and per dollar of Gross Domestic Product (GDP) is among the highest in the world. Its legacy of low energy prices has resulted in an energy intensive industrial base, but even when subtracting industrial energy requirements, British Columbians still rank high in per capita energy use. British Columbia uses two to three times more energy per capita than Japan or Sweden, suggesting it is possible to use less energy without reducing our standard of living.

Environmental Impacts

Energy has an impact on the environment to differing degrees in the generation, refining, transmission, storage, and end-use stages of the energy cycle. Electricity generation, either by hydroelectric or thermal-electric means, tends to have the most significant environmental impacts at the production stage (i.e. reservoirs and generating stations) whereas fossil fuels generally have the largest impacts at the end-use stage as a result of combustion.

Fossil fuel emissions cause known, and suspected, impacts upon the atmosphere and climatic environment. Fossil fuels used for internal combustion engines generate a wide range of emissions such as carbon monoxide, nitrogen oxides, sulphur dioxide, ground level ozone, and volatile organic compounds and particulate matter. These emissions cause urban smog, acid deposition, and potential climatic impacts from carbon dioxide and other greenhouse gases. Greenhouse gases are thought to be responsible for global warming as well as stratospheric ozone depletion.

Energy also causes land-related impacts associated with the generation, storage, and transportation of energy. Dams provide valuable power and flood control benefits, however, hydro-electric dams and reservoirs can result in loss of valley land and wildlife habitat, and cause migration obstructions. Transmission lines, and oil and natural gas pipelines similiarly can have environmental impacts during construction and operation. Energy production and transportation can result in water-related impacts such as fish habitat and migration losses, thermal pollution from thermal-electric plants, and aquatic oil spills. Another potential concern is the issue of electromagnetic fields around cables, wires,

fixtures, and appliances, a topic that is presently undergoing extensive research. Nuclear power also presents risks in terms of potentially unsafe radioactive emissions and effluent discharges, and the long-standing problem of permanent disposal of nuclear fuel waste.

Toward a Sustainable Development Strategy

The condition of the environment is a basic resource on which British Columbia's continued economic development and social well-being depends. The role of energy is central to our transition toward sustainable development. Environmental concerns must be considered as carefully as social and economic policy objectives when energy strategies are being developed. Though the challenge is formidable, the transition to sustainable development is not an option but an imperative. The United Nations' report referred to earlier concluded that there are no simple environmentally or economically viable energy pathways to the world's future development.

A report completed this year by the Commission of the European Communities emphasizes the fact that current energy and environmental policies are on a collision course.[2] The report strongly recommends the need to integrate environmental concerns with energy policy. This is expected to lead to binding directives and regulations for European Community members. A cornerstone of the Commission's plan is energy efficiency and conservation including mandatory least-cost planning, support of public transport, and efficiency standards for vehicles and appliances.

The key to affecting positive change in the energy sector is to realize that as individuals, we demand energy services that have environmental impacts related to all phases of energy production, transportation, and fuel use.[3] If energy consumers fail to adjust their attitudes and consumption patterns to take into account the impacts of their demands, sustainable development initiatives will not be successful. In a sustainable development world the balance of initiatives must shift from producer to consumer, from energy supply to energy services, and from quantity to quality of energy.

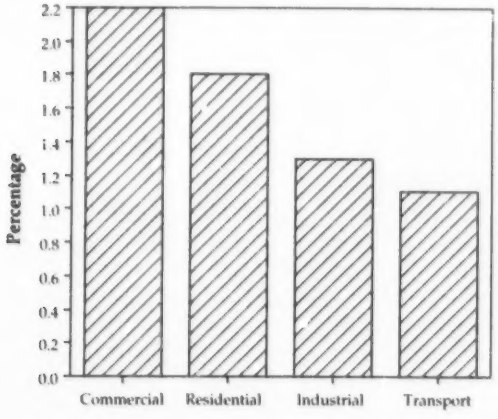
[2] *C. Hope and S. Owens (1990) "Two Cheers for EC Energy and Environmental Policy"* ***Energy Policy****, September 1990.*

[3] *The concept of energy services emphasizes the fact that energy as we understand it is a "currency". Energy can be produced by various sources, such as hydraulic energy from falling water or natural gas. This produces an energy currency, such as electricity to power a light bulb that produces a service - illumination.*

Energy Demand

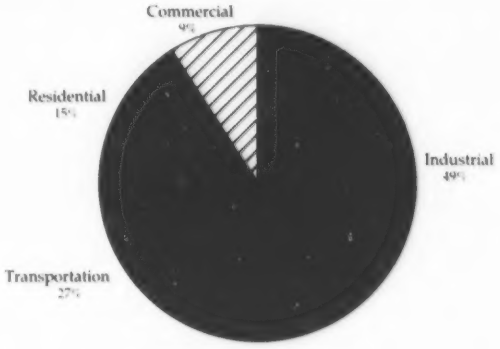
Issues

Energy demand in British Columbia is forecast to increase by 1.4% per year over the period 1990 to 2010. By sector, forecast energy demand growth rates are expected to be: commercial 2.2%, residential 1.8%, industrial 1.3%, and transportation 1.1%. Within the commercial sector, natural gas is expected to be the fastest growing fuel type increasing from 36 petajoules (PJ) to 63 PJ by 2010.[4] Similarly, natural gas is expected to be the fastest growing fuel in the residential sector, increasing 2.3% per year from 81 PJ to 128 PJ in 2010. Electricity demand is forecast to increase by 2.4% per year from 43 PJ to 69 PJ in 2010.



British Columbia Energy Annual Demand Growth By Sector: 1990-2010

Current annual energy consumption in the province is about 960 PJ. Of this, the industrial sector and particularly pulp and paper uses 49%, transportation 27%, residential 15%, and commercial 9%.



Total: 960 Petajoules

British Columbia Energy Consumption By Sector: 1990

The current population of British Columbia in 1990 is estimated to be 3.1 million, of which 73% or 2.3 million are concentrated in the Southwest region of the province.[5] The population is forecast to increase by an average rate of 1.7% per year between 1990 and 2011. British Columbia's future population is expected to be 4.4 million by 2011, increasing to 4.7 million by 2016. Over this period the population's median age, currently 34 years, is expected to increase to 41 years by the year 2016. This reflects the fact that a greater proportion of the population will be older and wealthier in the future, which may suggest a greater per capita demand for residential and commercial energy services.

Within the transportation sector, the second biggest energy user at 27%, motor gasolines and diesel fuel account for about 75% of the total energy used. The balance of fuels used in the transportation sector is divided between aviation fuels, heavy fuel oils, and other refined

[4] *A petajoule (PJ) is equivalent to 950 billion Btu's (approximately the energy consumed by the City of Vancouver each day). Petajoules are measures of energy that allow comparison of different forms of energy in common units.*

[5] *Patricia Ngan Consulting (1990)* ***British Columbia Population Forecasts and Issues***

petroleum products. Gasoline demand has been affected by a slowdown in the trend over the last 15 years to more fuel efficient vehicles. The stock of motor vehicles is expected to increase in British Columbia at an annual rate of about 2%. This rate exceeds the forecast rate of population growth of 1.7% per year over the next 20 years.

In 1990 60% of all the oil used in British Columbia was consumed by the transportation sector. Transportation fuels cost $3.5 billion in 1989, which is nearly one-half of British Columbia's total energy bill. The transportation sector is a major cause of urban air pollution, primarily caused by the combustion of gasoline and diesel oil in motor vehicle engines. Air quality in the Lower Mainland has become a particular problem, primarily as a result of carbon monoxide, nitrogen oxides, and hydrocarbons that can lead to the formation of ozone, a major lung irritant.

Within the industrial sector, pulp and paper is the province's major energy user. With a continued trend toward chemi-thermalmechanical and thermalmechanical pulp processes, these processes are expected to increase their provincial share of total pulp production. This technology is twice as electricity-intensive as traditional chemical pulping processes, but has much higher efficiency, transforming 95% of the fibre into pulp, as compared to 50% for chemical processes. With increased fibre utilization, less woodwaste will be available for self-generation of power in the pulp and paper industry. Pulp mills presently generate about 60% of their energy requirements by burning wood waste.

Options

Status Quo

One option is to "do nothing", resulting in unabated energy demand and all the environmental problems associated with unconstrained energy use and continued reliance on oil-based fossil fuels. It is suggested that the status quo scenario cannot be sustained.

Reduce Energy Services

Another option is to simply reduce energy services in certain cases such as transportation. Car-pooling and public transit are energy saving alternatives for individuals commuting and would reduce urban congestion and emissions. By simply doubling car occupancy in the Lower Mainland, gasoline consumption and automobile congestion may be reduced by nearly one-half. Public transit systems are only successful however, when commuters would rather use the facilities than drive their own automobile. Walking and bicycling are also alternatives that face consumer resistance unless governments make it easier by providing sidewalks in suburban areas and bicycle lanes, as is common in European cities.

Other opportunities exist for modifying the urban design to reduce commuting distances and to better link road, rail, and air transportation networks. Commuting can also be reduced by locating business activity near employees' homes or by telecommuting that allows employees to be linked by computer to their place of employment. The Netherlands is developing national zoning laws to discourage commercial and residential construction in places that are not easily accessible by major public transit terminals.

Another possibility is to consider economic development policies that may lead to less energy intensive industrial growth. It is recognized that our low-cost energy supplies have encouraged energy intensive primary resource processing. But the question should now be asked - how can we introduce policies that can encourage further resource processing prior to export? Energy and industrial policies should be aimed at further

processing of our raw materials, which is typically less energy intensive on a per dollar of output basis and can add further value to our exports.

Maintain Energy Services

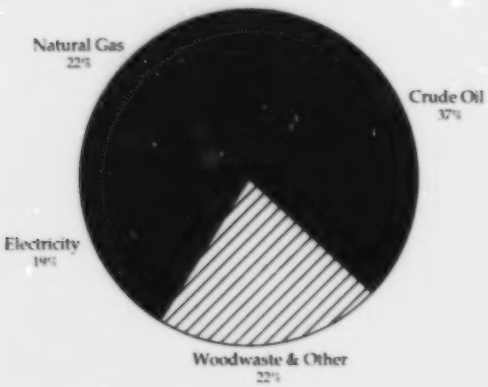
The most attractive option may be to maintain our current level of energy services by improving our energy using technology. Improving energy efficiency can reduce environmental impacts and energy costs and, in many cases, can be self-financing. In the transportation sector the most effective means to achieve reductions in total vehicle emissions will likely be overall energy efficiency gains. Although fuel efficiency guidelines were introduced in the 1980's, interest in fuel efficiency appears to have declined since 1986 when oil prices collapsed.

There are many options to maintain energy services and to improve energy efficiency. Energy prices that reflect full environmental costs may lead to better energy efficiency technologies. Stronger conservation measures and alternative fuels that have less damaging environmental impacts are options that can be cost-effective and should be seriously considered.

Energy Supply

Issues

British Columbia's current energy requirements are supplied by the following fuel types: 37% by oil, 22% by natural gas, 22% by woodwaste and other fuel types, and 19% by electricity.



British Columbia Energy Use by Fuel Type

Although British Columbia exports electricity, natural gas, and coal, it must import 80% of its crude oil requirements from Alberta. More than 60% of the demand for crude oil products comes from the transportation sector. At present, oil represents 37% of our energy supply, but costs us about 50% of our total energy bill as well as causing significant environmental impacts. With domestic production in decline and future requirements on the increase, British Columbia's dependence on oil imports can only increase.

Hydroelectricity generation accounts for 95% of all electricity production in the province. BC Hydro and West Kootenay Power are the two major power utilities and together produce 85% of the province's electricity. Alcan, Cominco, MacMillian Bloedel, and other smaller companies are major industrial hydroelectric producers that generate electricity for their own requirements. Pulp and paper mills account for most of the industrial thermal power generation, cogenerating electricity and steam from woodwaste, heavy fuel oil, natural gas, and pulping liquors. Although the pulp and paper sector is a large energy user, it is approximately 60% self-sufficient in its energy requirements.

BC Hydro has announced its intention to purchase power from the private sector for domestic requirements. Four competitively priced proposals have been short-listed: a 113 MW coal project near Elkford, a 92 MW natural gas cogeneration project at Taylor; a 20 MW hydro plant near Squamish, and a 55 MW woodwaste project at Williams Lake. BC Hydro's export subsidiary, Powerex, has also short-listed five private generation projects for potential export. These projects include a 220 MW natural gas plant near Merritt, a 169 MW woodwaste and natural gas plant in the Interior, a 150 MW natural gas turbine at Chilliwack, a 85 MW cogeneration project near Crowsnest and a 305 MW coal plant near Sparwood.

British Columbia has sufficient natural gas reserves to support new domestic and export markets well into the next century. Established domestic reserves are estimated to be sufficient for at least 20 years at current levels of production. Undiscovered potential reserves could represent an additional 50 years of supply. The Vancouver Island pipeline represents a new domestic market and is expected to be in-service by late 1992. Natural gas deregulation and declining United States productivity have opened up new export markets for British Columbia gas producers. Potential exports to California could increase natural gas production from less than 400 PJ currently to more than 500 PJ in the mid-1990's.

Given that the supply of energy services is essential to our economic well-being, the question is not if we need new energy supplies, but rather when should they be

developed and how can their environmental impacts be minimized. The key supply issues so far identifled are:

- Energy saved through conservation and energy efficiency is environmentally benign, suggesting that energy conservation should be valued at a premium for its environmental benefits.
- British Columbia's dependence on oil and in particular refined petroleum products with their resulting environmental impacts, cannot be sustained in the long-term.
- Proposed thermal generation projects to produce electricity for domestic and export use should be carefully considered in view of their environmental impacts as compared to less polluting alternatives such as hydroelectricity.

Further, there appears to be a need for a comprehensive British Columbia energy plan that emphasizes energy efficiency investments across all fuel types and energy suppliers, and is produced every two years.

Options

Conservation and Least-Cost Planning

Least-cost planning treats energy efficiency savings as a resource like any other conventional supply option and is a legislated requirement in many areas of the United States. Least-cost planning is an integrated planning method that assesses the economics of all potential energy sources, including conservation and energy efficiency, in order to meet energy growth. A least-cost plan identifies alternative forecasts of energy demand and compares them to a mix of resources including efficiency measures, renewables (i.e. woodwaste, hydroelectricity), power purchases, and traditional generating resources. Least-cost planning simply recognizes the fact that energy should be saved first, if it costs less than buying new supplies. It is a planning technique based upon the sequential exploitation of energy supply, including conservation, with lowest cost resources used first.

BC Hydro has established priorities that incorporate some of the aspects of least-cost planning practice.[6] BC Hydro's development priorities include: Power Smart (end-use conservation), power system coordination and purchase from other large producers, Resource Smart (improvements to their generating system), private sector generation, and new hydroelectric generation, in that order. BC Hydro does not have the mandate to examine all fuel types or thoroughly investigate all possibilities of integrating energy conservation opportunities with other supply options.

In the State of Washington, the Washington Utilities and Transportation Commission requires all investor owned natural gas and electric utilities to develop least-cost plans every two years. These plans must assess the availability and costs of energy efficiency and conventional generating options. These supply options must be integrated to produce a long-range plan that contains specific actions for the first two years of the planning period. British Columbia has no such requirement.

The United States Pacific Northwest Electric Power Planning and Conservative Act of 1980 established an agency with a broad mandate to investigate least-cost planning and to integrate Columbia Basin fish and wildlife concerns. The Pacific Northwest Electric Power and Conservation Planning Council is an interstate council including, Idaho, Montana, Oregon and Washington. The Planning Council is responsible for electric power planning in the United States Pacific Northwest and uses a comprehensive public involvement and review process.

The creation of the Planning Council arose, in part, from recognition of the market constraints that act against achieving appropriate conservation

[6] *BC Hydro (1990), **Electricity Issues for the 90's.***

investment. In view of these constraints, reliance on market forces alone will result in under investment in energy efficiency and an over investment in conventional supply sources. A recent Canadian government report prepared by a House of Commons committee concludes that current Canadian energy policies focus too heavily on conventional fossil fuels and that energy efficiency and clean energy alternatives should be our primary objectives.

British Columbia needs to do more research into energy service costing of alternatives to determine the economic potential of least-cost planning. This should be done for all fuel types and energy supplies, not just for electricity. Since many environmental problems and their solutions are transboundary in nature, British Columbia must continually consult with other jurisdictions to develop abatement strategies. Interjurisdictional cooperation could more easily identify lower cost or more beneficial abatement strategies than could any single jurisdiction independently.

Oil Substitution

Crude oil provides 37% of British Columbia's total energy requirements, which is more than any other fuel type. Increased use of our hydroelectric resources could potentially reduce oil and coal dependence and provide time for development of better thermal and nuclear technologies. With British Columbia's abundant hydroelectric and natural gas resources, the province may be well positioned to show leadership in reducing the use of fuels that are harmful to the environment.

In the early 1980's, the federal government designed many initiatives to encourage energy conservation through oil substitution and energy designed alternatives. These programs were designed primarily to improve energy security and reduce the total expenditures on oil imports. Since the oil price collapse of 1986, federal energy policy has focused on increasing the supply of conventional fossil fuels rather than developing cost-effective conservation and clean energy alternatives. Although the reasons for oil substitution strategies have changed, the advantages of using energy efficiently have not.

There are many environmental disadvantages attached to the continued reliance on fossil fuels, especially high carbon fossil fuels, yet consumption has rapidly increased since the mid-1980's. In addition to the environmental advantages, a program of oil substitution could improve British Columbia's trade position as 80% of our crude oil requirements are imported. Heavy dependence on oil imports, combined with unstable world oil prices, creates a risk of impact on the British Columbia economy. There are cost-effective options that can enable us to shift away from high carbon fossil fuels to natural gas or even cleaner fuels, such as hydroelectricity.

Alternative Energy

British Columbia's energy strengths in electricity and natural gas suggest active technological leadership in encouraging cleaner alternative road fuels such as electricity, hydrogen, and compressed natural gas. Development of hydrogen and electric powered road transport promises the greatest environmental benefits provided the production of the energy does not contribute harmful emissions. Compressed natural gas for motor vehicles can offer immediate gains both environmentally and economically, and therefore can act as a transition fuel until hydrogen and electric vehicles become a reality.

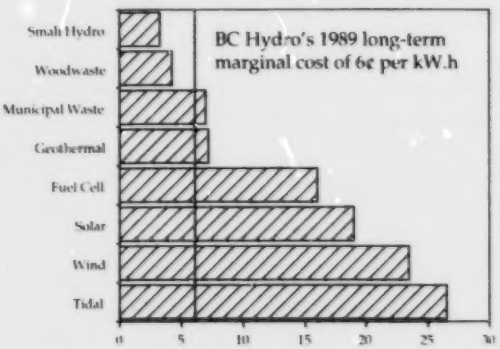
Currently British Columbia has the largest proportion of natural gas vehicles (NGV) in North America (about 15,000 vehicles). The NGV infrastructure is growing and at present has about 50

public refuelling stations. Natural gas has clear environmental advantages over gasoline, producing 90% less hydrocarbons, 82% less carbon monoxide, and 20% less carbon dioxide. Advanced engine design in cars, trucks, buses, and ferries could optimize the use of natural gas while displacing oil requirements and reducing air pollution from transportation in British Columbia. Continued research and improvements on NGV and on other aspects of alternative fuels appears consistent with sustainable development.

Alternative fuels require additional government support through research, development, demonstration, fiscal incentives, and regulation to enable non-conventional vehicles and technologies to compete with fossil fuels. The fossil fuels industry has traditionally received special tax and fiscal incentives to encourage supply, but financial assistance to alternative fuels is often considered a subsidy. Clean burning alternative fuels can replace gasoline and diesel fuels with a significant improvement in emissions, operating costs, and reduced carbon dioxide production.

Hydroelectricity, wind, and solar energy sources can generate power without emissions. The combustion of woodwaste fuels generates carbon dioxide, but these emissions are releasing the carbon dioxide that was originally absorbed when the tree was alive. In British Columbia several of these alternative energy sources have been investigated and include: small hydro, woodwaste, geothermal, solar, wind, tidal, ocean waves, and municipal solid waste. Many environmentally beneficial energy alternatives are technically possible, but are presently not economically feasible when compared to the costs of conventional energy sources.

The graph below compares BC Hydro's 1989 long-term marginal cost of 6 cents per kilowatt hour (kW.h) with the cost of various alternative energy sources. Small hydroelectric, woodwaste, and municipal solid waste-fired thermal plants are currently economically viable for the generation of power to BC Hydro's integrated grid. As a result of low natural gas and electricity prices, British Columbia has a surplus of woodwaste that could be used to produce electricity. Woodwaste not used for power generation by the forestry industry is currently incinerated without producing power benefits. The potential of using additional surplus woodwaste to generate power in the province is significant.



Alternative Energy Supply Costs[7] ($1989 ¢/kW.h)

Municipal solid waste (MSW) can produce energy and extend landfill life, but environmental and economic considerations must be addressed. Geothermal power production technology is proven, but further exploration is required to develop these potential power resources, such as at the Meager Creek and Mt. Edziza sites. Fuel cell power plants are nearing commercialization and research units as large as 10 MW are now being developed in North Vancouver. Solar cells are expected to be cost competitive with conventional utility generation in the United States by the late 1990's. Cost estimates for solar power at Cranbrook, the sunniest location in British Columbia, indicate that energy costs are still three times higher than system marginal costs.

[7] *BC Hydro (1990) **Electricity Issues for the 90's***

Wind turbine technology is now well developed with more than 1700 MW of capacity installed world-wide. The wind resource in British Columbia has not been fully assessed, but costs are estimated to be between two to three times system marginal costs. Tidal energy technology is also proven and a large resource potential is available in the province, but at a cost of about five times BC Hydro's system marginal costs.

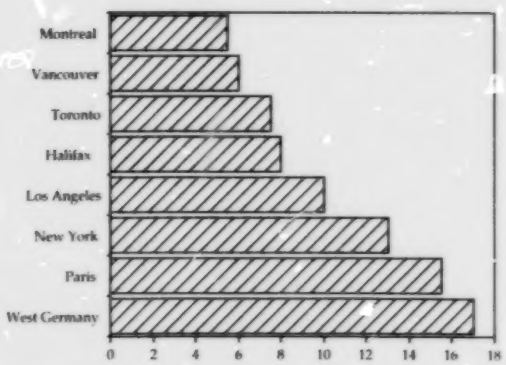
Pricing

Issues

There are essentially two ways to improve market constraints affecting environmental and conservation objectives in energy markets: regulation and standards; and economic instruments such as pricing, taxes, and subsidies. Energy prices play a major role in determining the quantities and types of energy that are produced and consumed. Prices, taxes, and subsidies provide the financial incentives or disincentives that influence energy supply and demand decisions.

The Provincial Government influences energy prices through the Utilities Commission that sets utility rates for provincial utilities. It also influences prices through setting water rental payments, oil and natural gas royalties, and a variety of fees, taxes, and subsidies. In terms of improving energy markets with respect to environmental and energy efficiency goals, the economic instruments of royalties, taxes, and subsidies can offer an effective means of improving energy supply and demand decisions.

British Columbia's electricity rates are among the lowest in the world. In most cases these rates do not reflect the full economic and environmental costs, and therefore contribute to waste via excessive energy use and avoidable environmental impacts.



Comparative Residential Electricity Prices: 1990

($1990 ¢/kW.h)

Note: Based on a monthly consumption of 750 kW.h

BC Hydro recognizes that the replacement costs of electricity are significantly above current rates. Continuing to charge rates that do not reflect replacement costs encourages electricity use and acts to accelerate premature development of new resources. In addition, for electricity rates to reflect replacement costs, they should also attempt to recover full environmental costs. Full cost accounting suggests that the costs of new power supplies should include allowances to cover all quantifiable environmental impacts, including compensation and mitigation. It should be recognized that even by doing this, environmental costs fall short of covering all costs because many of the impacts cannot be objectively valued.

Natural gas in British Columbia is provided by a mix of large and small producers that are largely deregulated, and local distribution companies that are provincially regulated. These companies are privately-owned, and compete for domestic and export market share. There are strong incentives to sell large volumes of natural gas and explore for new reserves. Although long-term replacement cost pricing policies exist for electricity, there are none for natural gas or oil in British Columbia.

Private utilities are motivated to expand their customer bases and therefore do not profit from customers reducing consumption through conservation initiatives. Unlike BC Hydro, private utilities have little incentive to pursue energy efficiency since this would reduce sales. New regulations may be required to provide private utilities with the incentive to invest in and use efficiency measures.

Oil prices in British Columbia are unregulated and tend to be more responsive to world energy markets than natural gas. The majority of British Columbia's oil is imported from Alberta and refined in the Lower Mainland. Heavy fuel oil is barged in from the United States and used in coastal pulp mills. This practice will decline as natural gas becomes available on Vancouver Island and the Sunshine Coast by late 1991.

Options

Full Cost Accounting

The most effective way to reduce environmental damage from energy is to raise energy prices through the adoption of full cost accounting. To prevent overconsumption of energy, prices ideally should incorporate environmental and resource depletion costs. Resource depletion costs are similar to depreciation costs in the sense that present consumption brings forward the need for more expensive future supplies. Full cost accounting can provide the proper pricing signals to industry and consumers for wise resource use in the long-term. Subsidies, incentives, and underpricing are common in the energy supply industry, and act to encourage non-sustainable energy use.

Proper pricing requires that the natural assets that go into the production of energy or that have an impact on its use, be fully valued to ensure proper use and allocation. The pricing and taxation of energy services therefore needs to be analyzed from a uniform provincial perspective. The perspective should be long-term, incorporate least-cost planning criteria, and take environmental and non-priced values into account.

Application of this strategy suggests energy prices might increase gradually and predictably to facilitate long-term adjustment of the economy. BC Hydro has proposed a pricing premium of up to 15% that it may pay for electricity generated in a way that produces an environmental benefit. Consideration should be given to extending this pricing premium to energy efficiency gains because energy saved through conservation generates no new environmental impacts.

A related issue for the 1990's is BC Hydro's obligations to serve major new industrial loads. BC Hydro's costs of bringing new power supplies onto their system exceeds the revenue they would earn from serving a new load, such as a new pulp mill. Several United States utilities are using innovative connection charges and power rates that are tied to a new load's level of efficiency. Consideration is also being given to paying rebates to energy efficient loads as inducements to save energy, when it is economic to do so.

Regional Electricity Costs

Related to the issue of full cost accounting is the fact that electricity rates charged are average "postage stamp" rates that do not vary according to the location of the customer. The costs of new electricity supply is affected by the costs of transmission required to deliver the power from the generating station to the point of consumption. Transmission losses vary by distance and by the relative loadings on the transmission circuits. These factors act to create regional differences in the cost of new electricity supply.[8]

[8] BC Hydro (1990), ***The Costs of New Electricity Supply in British Columbia***, *Resource Planning.*

Under the Economic Development Electricity Rate Act, the Provincial Government has the authority to offer lower power rates than those paid by other customers of BC Hydro, in order to attract new industry. The fact that electricity costs vary regionally has implications in attracting new industry to British Columbia. Industries locating near the source of generation could be provided lower power rates that reflect transmission cost savings. This option is consistent with full cost accounting and avoids offering power at rates below costs, which stimulate wasteful overconsumption.

Global Warming

Issue

Atmospheric scientists warn that the temperature of the Earth's atmosphere is warming as a result of an increase in man-made greenhouse gases. These gases, as the name implies, allow the Sun's energy to enter the atmosphere but prevent outgoing radiation from the Earth's surface and lower atmosphere from escaping. Human activities, such as clearing the forests and burning fossil fuels with the subsequent release of certain gases such as methane, nitrogen dioxide, ozone, chlorofluorocarbons (CFCs), and halons (used in fire extinguishers) are causing global concentrations of greenhouse gases to rise.

The Earth's average temperature has risen by about 0.6 degrees Celsius during the past 100 years. Concentrations of carbon dioxide, which accounts for about 50% of the greenhouse gases, has risen by 25% since the beginning of the Industrial Revolution. Since 1950, the level of carbon dioxide has increased by about 10% and appears to be increasing at about 0.5% per year. As a result of the increase in greenhouse gases, atmospheric scientists predict an increase in the earth's temperature in the range of 2.5 to 5.5 degrees Celsius by the middle of the next century. The Earth is expected to be warmer by 2030 than it has been in the last 120,000 years.[9]

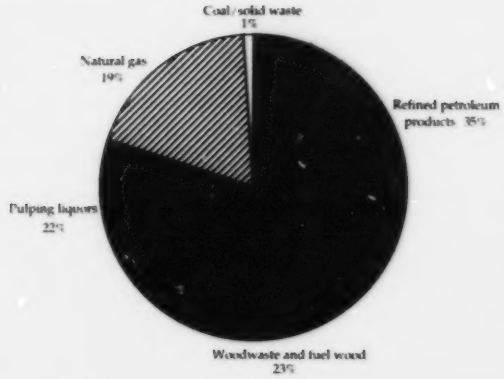
The climatic impacts of global warming are predicted to result in greater extremes in storm intensity, increased sea-levels and ocean temperatures, flooding of river delta areas, and disruption of plant life, animal life and agriculture. For British Columbia, hotter dryer conditions will reduce hydroelectric capability and increase water demand, and droughts in the Interior can be expected to be more severe. This will create a variety of problems for agriculture (reduced irrigation and water availability), and for the forestry sector (reduced growth, increased fire hazard). Although plants may benefit from increased carbon dioxide, increased temperature and drought could significantly reduce growth and geographically shift growing areas.

Thermal expansion of the ocean and melting of polar and glacial ice is expected to increase British Columbia's sea-level by approximately one metre. This will result in flooding of low-lying coastal settlements, and require large expenditures for relocation of structures and flood prevention in areas such as Richmond. Higher ocean temperature will likely have a major effect on the province's fisheries, including a possible change in species composition. Rising ocean levels and reduced summer river flows will change coastal and delta wetland habitats with corresponding impacts upon wildland plant and animal species. The potential impacts of global warming upon the British Columbia economy have not been assessed.

The Provincial Government has recently completed a provincial inventory of carbon dioxide emissions.[10] This study estimated that total provincial carbon dioxide emissions were at 84,400 kilotonnes. The forestry sector, which includes the pulp and paper industry, slash burning and woodwaste incineration, accounted for the majority of emissions estimated at 54,100 kilotonnes per year in 1988. In terms of provincial carbon dioxide emissions arising from energy combustion, the major contributors were gasoline and diesel fuel 35%, wood waste and fuel wood 23%, pulping liquors used in the pulp industry 22% and 19% from natural gas.

[9] *Linda Starke (1990)* ***Signs of Hope: Working Toward Our Common Future,*** *The Centre for Our Common Future, p.20; and Task Force on the Energy and the Environment (1989)* ***Report on Reducing Greenhouse Gas Emissions.*** *Federal/Provincial/Territorial joint report.*

[10] *B.H. Levelton and Associates (1990)* ***Carbon Dioxide Inventory For British Columbia,*** *Ministry of Energy, Mines and Petroleum Resources. A kilotonne is 1,000 metric tonnes equal to about 2.2 million pounds.*



British Columbia Carbon Dioxide Emissions From Fuel Combustion: 1988

Although the forestry sector is responsible for more than two-thirds of the man-made carbon dioxide emissions, it has been estimated that the forests of British Columbia absorb about 198,000 kilotonnes of carbon dioxide each year. Total carbon dioxide absorption for forests, rivers, lakes, and wetlands has been estimated to be 203,200 kilotonnes for 1988. On balance the Province absorbs more carbon dioxide than it releases. The impacts of global warming however, are world-wide and will have significant environmental and economic implications for British Columbia.

Options

Status Quo

The option exists to ignore the warnings of global warming, but this option goes against advice given in a recent declaration made on November 4, 1990 in Geneva. At that meeting, 700 of the world's top scientists strongly urged all governments to take immediate action on the global warming issue. The declaration, prepared by experts from more than 100 countries, stated that "Notwithstanding scientific and technical uncertainties, nations should now take actions toward reducing sources and increasing sinks of greenhouse gases".[11]

No Regrets Policy

Although irrefutable proof linking the increase in greenhouse gases and global warming is not yet available, the issue poses a dilemma between action and delay. If we delay for further study and proof of the cause of global warming, the effectiveness of our future actions will decline and the damage may become irreversible. A solution to this quandary is to develop a "no-regrets" strategy. A no-regrets strategy would encompass broad ranging actions that are economically and environmentally beneficial on their own, even if the dangers of global warming do not fully materialize.

The conference, "Changing Atmosphere: Implications for Global Security," held in Toronto in 1988 made a recommendation that nations adopt the objective of reducing carbon dioxide emissions 20% of 1988 levels by the year 2005. Although this recommendation has gained support in Canada and elsewhere, the council of Federal and Provincial Energy Ministers, concluded in April, 1990 that the implications of a 20% reduction target on the economy were not economically acceptable. Since then, the Federal Minister of Environment confirmed the earlier decision not to target a 20% reduction even though the target was recently supported by an all-party House of Commons report on the environment.

The Federal Government's Green Plan, released in December 1990, outlines the federal strategy to deal with greenhouse gases and carbon dioxide. The Green Plan identifies a national goal of stabilizing emissions of carbon dioxide and other greenhouse gases at 1990 levels by the year 2000. For emissions of carbon dioxide however, the Federal Government indicates that the measures outlined in the Green Plan may not be sufficient to meet the national target. Other nations have adopted more ambitious targets and strategies of reducing emissions.[12]

[11] *Anne McIlray (1990), "Declaration by Scientists calls for Warming Action", **Vancouver Sun**, November 5, 1990, p. D12.*

[12] *Linda Stark (1990), **Signs of Hope: Working Toward our Common Future the Centre for Our Common Future**, p. 53.*

The Netherlands aims to freeze carbon dioxide emissions at 1989/90 levels by the mid-1990's. In January of 1990 the Netherlands introduced a tax on fossil fuels linked to their carbon concentrations per unit of energy. Norway has adopted the objective of freezing carbon dioxide emissions by the end of the 1990's. Sweden hopes to limit carbon dioxide emission levels to 1990 levels. Denmark has vowed to cut carbon dioxide emissions to 50% of 1988 levels by 2030. West Germany, prior to unification, hoped to achieve carbon dioxide emission reductions of 75% of 1987 levels by 2005. British Columbia has the option of establishing its own carbon dioxide emission target based upon its resource strengths.

The following suggests a "no-regrets" strategy for British Columbia.

1. Improve Energy Efficiency

There are no simple ways to reduce greenhouse gases and especially carbon dioxide from fossil fuel combustion. Increasing energy efficiency through aggressive cost-effective conservation measures is the fastest way to reduce carbon dioxide emissions and energy costs. Energy efficiency investment if cost-effective, is self-financing through annual energy cost savings and benefits the environment through reducing other undesirable emissions.

2. Reduce Fossil Fuel Dependence

As outlined above there are many advantages in reducing oil-based fossil fuels besides reducing carbon dioxide emissions. Oil substitution can help improve the province's balance-of-payments and reduce the risks of oil price volatility. Attempts in the early 1980's to reduce fossil fuel use have shown that oil substitution is difficult in the transportation sector. Average motor vehicle fuel consumption has fallen by approximately 50% as compared to typical levels in 1975. At the same time, more stringent emission regulations have reduced urban pollutants as a result of more complete combustion of fuel and catalytic conversion of carbon monoxide, nitrogen oxides and hydrocarbons into carbon dioxide, nitrogen, and water.

3. Increase Environmentally Benign Energy Alternatives

Energy options that do not emit carbon dioxide or emit less should be valued for this advantage. Hydroelectricity can generate competitively priced energy today, without producing emissions of any kind. Natural gas can be used in many applications in place of oil with reduced carbon dioxide and other emissions. These opportunities and others should be identified and become part of a no-regrets strategy.

4. Interjurisdictional Cooperation

Transboundary cooperation may allow the possibility of identifying lower cost, more beneficial strategies than if restricted to only a single jurisdiction.

5. Reforestation

Another possibility is to accelerate the planting of forests to increase the amount of carbon dioxide absorbed. This would benefit the forestry sector as well as assisting with a difficult environmental problem. It has been estimated that a single 500 MW coal-fired power plant would generate the same amount of carbon dioxide that could be absorbed by about 1,000 square miles of new forest.[13]

Reduction Target

British Columbia has the option to adopt a specific greenhouse gases reduction target beyond that achievable by a no-regrets policy. The target could be achieved by implementing increasingly expensive measures, and should involve a combination of strategies based upon all greenhouse gas emissions, not just carbon dioxide.

[13] *Scientific American Inc. (1990), **Energy for Planet Earth: Special Issue**, September, 1990 Issue, p. 134.*

Summary of Issues and Options

Development of sound environmental policies for British Columbia can complement good long-term economic development policies. The integration of environmental objectives into economic policy is a long-term activity, recognizing that the economy requires time to adjust while maintaining its international competitiveness.

Energy Demand

British Columbia has an energy-intensive economy that is expected to continue to grow. The level of energy services can be maintained and increased to accommodate economic growth. The challenge for us is to significantly improve our efficient use of energy and shift to energy alternatives that cause less damage to environment. Policies might also aim at encouraging further processing of our resources prior to export, rather than more energy intensive primary processing.

Energy Supply

British Columbia's competitively-priced energy supply choices are difficult since they all involve major environmental trade-offs. Hydroelectric developments produce no emissions, but result in the loss of valuable valley lands. Continued heavy reliance on oil-based fossil fuels cannot be sustained, but available alternatives generally only reduce rather than eliminate emissions. It is recognized that the increased use of natural gas, in place of refined oil products, may provide a transition phase of perhaps 10 to 20 years until environmentally benign energy alternatives such as hydrogen and electricity become available for a wider array of energy services.

Energy Pricing

British Columbia's low energy prices have encouraged development of an energy intensive economy and inefficient energy use, the environmental implications of which are now being realized. To avoid wasteful energy use, energy prices could be based on full cost accounting that reflects environmental and future replacement costs. Any such move toward full cost accounting of energy prices should be gradual in order to facilitate long-term adjustment of the economy.

Global Warming

It is the recommendation of a large number of the world's scientists that governments should act upon the global warming issue, yet to date Canada and the United States have been reluctant to commit to any targets. Although British Columbia is a net absorber of carbon dioxide due to its large forest area, the trend is on the decline due to increasing fossil fuel use and the conversion of forest land to other uses. Whether the logging of old growth forests, even if later reforested, contributes to global warming continues to be a point of debate. British Columbia has an opportunity to show leadership by developing a strategy to begin to deal with this global problem.

Comprehensive Energy Planning

Public involvement will inevitably become a necessity in the 1990's as energy supply issues become increasingly more complex, involving difficult social, environmental, and economic trade-offs. The public should become part of the decision-making process and have a defined role in deciding what combination of energy supply options are acceptable. The public should be aware of all competitively priced energy supply alternatives and their environmental impacts. If designed and operated properly, public involvement will not lead to delay but, rather, can provide a more predictable regulatory time path for decision-making processes.

It may be in British Columbia's interest to set up a planning function similiar to the Pacific Northwest Electric Power and Conservation Planning Council with a mandate of least-cost planning, conservation, environmental evaluation and public involvement. The objective of such a comprehensive energy planning function would be to prepare a biennial energy plan, based upon least-cost planning criteria, that emphasizes efficiency investments across all fuel types and energy suppliers. More research is needed into devising more acceptable ways of incorporating environmental values into energy supply and costing procedures to support such planning.

How You Can Get Involved

The British Columbia Round Table on the Environment and the Economy welcomes your comments on this paper, either in writing or at a public meeting. Please feel free to tell us your views on the issues raised in the search for a sustainable development strategy for British Columbia.

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Appendix

Available Theme Papers

Sustainable Land and Water Use
Sustainable Communities
Sustainable Energy

Available Background Papers

Decision processes for land allocation
Analytical methods for land allocation
Water allocation and management
Population changes
Air quality issues
Municipal water issues
Waste management issues
The British Columbia economy
Economic incentives
Resource accounting
Energy development processes
Transboundary issues